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Indian Standard
SPECIFICATION FOR SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS
(*First Revision*)

UDC : 656.251 : 681.7 : 066

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5 *February* 1985

AMENDMENT NO. 1 JULY 2007
TO
IS 1975 : 1984 SPECIFICATION FOR SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS

(*First Revision*)

(*Page* 6, *clause* **4.1.1**) — Substitute the following for the existing clause:

'**4.1.1** *Limit of Alkalinity* — The glass of the signal roundels and lenses, when graded according to the method prescribed in IS 2303 (Part l/Sec 1) : 1994*, shall conform to Class HGB 3.'

(*Page* 6, *footnote marked* *) — Substitute the following for the existing:

'*Grading glass for alkalinity Part 1 Hydrolytic resistance, Section 1 Hydrolytic resistance of glass grains at 98°C - Method of test and classification (*first revision*)'

(*Page* 12, *clause* **6.2.1**) — Substitute the following for the existing clause:

'**6.2.1** *BIS Certification Mark*

The roundels and lenses may also be marked with the Standard Mark.

6.2.1.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.'

(CHD 10)

Reprography Unit, BIS, New Delhi, India

Indian Standard

SPECIFICATION FOR SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS

(*First Revision*)

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(*Continued on page* 2)

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Indian Standard

SPECIFICATION FOR SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS

(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 May 1984, after the draft finalized by the Glassware Sectional Committee had been approved by the Chemical Division Council.

0.2 This standard was first published in 1961 under the title 'Colours for signal glasses for use in railways'. In this revision requirements in respect of quality of glass, dimensions of roundels and lenses used in Indian Railways, which were not covered earlier have now been prescribed. Further, alignment has been brought about with the colour, transmittance and other requirements as prescribed in IRS-S7-1976 'Specification for roundels and lenses', issued by the Railway Board, Ministry of Railways, Government of India, to make the standard comprehensive.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final values, observed or calculated, expressing the results of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified values in this standard.

1. SCOPE

1.1 This standard prescribes requirements and methods of sampling and test for signal roundels and lenses for use in railways.

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*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 1382-1981*, in addition to the following, shall apply.

2.1 Lens — A glass with one or both surfaces shaped so as to modify the divergence of rays when a small source of light is placed at its focus.

NOTE 1 — A lens may have a continuously curved surface on one face and discontinuous sections of lens formation on the other face.

NOTE 2 — The face having discontinuous surfaces (sections) comprises 'zones', and 'risers'. The profile of zones should be accurately moulded to give the desired focus to the lens or the combination for which the lens is intended. Risers connect and step the zones over the surface. Zones and risers may be identified by counting from the centre to rim of the lens; the centre lens formation being the first zone.

2.2 Inside Step Lens — A lens in which the discontinuous surfaces (sections) are on the concave side of the lens.

2.3 Outside Step Lens — A lens in which the discontinuous surfaces (sections) are on the convex side of the lens.

2.4 Doublet Combination Lens — A matched combination of an inside step outer lens and an outside step inner lens for the efficient utilization of light flux in a colour light signal.

2.5 Focal Length — The axial distance between the plane of lens setting and the point along the axis at which when a point source of light is placed, the lens as a whole transmits, as near as possible, a parallel beam of light.

NOTE — In the case of doublet combination of lenses, focal length is referred to from the seating of the inner outside step lens.

2.6 Nominal Focal Length — The focal length for which the lens is designed.

2.7 Angle of Spread —The angle included by that portion of the beam within which the intensity of the beam is not less than 50 percent of the candle power of the axial beam.

2.8 Colour — The colour of a signal roundels/lens is defined in terms of its chromaticity co-ordinates using the trichromatic system recommended by the International Commission in Illumination (CIE) in 1931. In this system, colour is expressed in the chromaticity co-ordinates x, y and z,

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*Glossary of terms relating to glass and glassware (*first revision*).

the turn of which it unity. The co-ordinate x is analogous to the proportion of red, y to the proportion of green and z to the proportion of blue.

2.9 Luminance — The luminous intensity of the light emitted per unit projected surface area.

2.10 Colour Limits — Colour limits are stated in terms of limiting values of some are all the three chromaticity co-ordinates x, y and z.

2.11 Colour Filter — The filter of glass or other material used to impart a distinctive colour to a signal.

2.12 Plain Colour Filter — A colour filter which effects no significant change in the direction of light normally incident upon it.

2.13 Chromaticity of a Filter — Chromaticity of a filter is defined by the chromaticity co-ordinates of the light reflected from a truly white screen (that is, magnesium oxide screen) illuminated only by light which passes through the filter in the manner intended in service.

NOTE — For the purpose of this specification the light source is deemed to be illuminant *A* of the CIE, that is a tungsten filament lamp operated at a colour temperature of 2 856° K.

2.14 Transmittance of a Colour Filter — The transmittance of a colour filter is defined as the percentage ratio of the luminance of a truly white screen, illuminated as in **2.13** above, to the luminance of the same screen when the colour filter is replaced by a non-absorbing medium of the same pattern and refractive index.

NOTE — For plain colour filters (*see* **2.12**) the transmittance is approximately 1.08 times the transmission factor.

2.13 Colour Temperature — The colour temperature of a white light source is taken as the absolute temperature on the kelvin scale (°K) of a full radiator, the colour of which is, as nearly as possible, the same as the colour of the white light source.

2.16 Truly White (Magnesium Oxide) Screen — A silvered plate on which pure magnesium oxide has been deposited to a thickness of at least 1 mm.

2.17 Diffuser — A filter which has one or both surfaces depolished or patterned so as to increase divergence of a beam of light passing through it.

2.18 Spreader — A filter which has one or both surfaces patterned so that the divergence of a beam of light passing through it is increased in one plane only.

2.19 The following definitions shall also apply if the material is intended for use in railways.

2.19.1 *Type Tests* — These are tests which are specifically specified for roundels or lenses in a distinctive manner.

2.19.2 *Acceptance Tests* — These are tests which are particularly specified by the purchaser to be carried out on the roundels or lenses at various stages prior to accepting the delivery.

2.19.3 *Routine Tests* — These are tests which shall be carried out on each roundels or lenses in general.

3. TYPES

3.1 The roundels lenses shall be of types and colours given in Table 1.

4. REQUIREMENTS

4.1 Material — Signal roundels and lenses shall be made of glass.

4.1.1 *Limit of Alkalinity* — The glass of the signal roundels and lenses, when tested in accordance with 2 of IS : 2303-1963* shall conform to at least Type 4, that is, titre value shall not exceed 3.0 ml of 0.01 N hydrochloric acid.

4.1.2 *Resistance to Thermal Shock* — The glasses shall withstand thermal shock of 55°C when tested in accordance with method D of IS : 6506-1972†.

4.2 Workmanship and Finish — Signal roundels and lenses shall be accurately moulded and shall be free from stones, seeds, bubles, blisters, streaks, deformities, chips, foreign particles, surface cracks, wrinkles, scratch marks or any other defect which may impair the appearance or affect the optical characteristics.

4.2.1 *Annealing* — Signal roundels and lenses shall be well annealed and the residual strain in them when tested in accordance with 4 of IS : 9153-1978‡ shall not be more than one standard strain disc corresponding to 22.8 ± 1 nm of optical retardation.

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*Method of grading flats for alkalinity.

†Methods for thermal shock tests on glassware.

‡Methods of polariscopic examination of glassware.

TABLE 1 RECOMMENDED DIMENSIONS AND COLOURS FOR SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS

(*Clause* 3.1, 4.3.1 *and* 4.4)

SL. No.	TYPE OF ROUNDELS AND LENSES	FINISH	DIAMETER	FOCAL LENGTH	COLOUR	USAGE
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			mm	mm		
i)	Roundel	—	38	—	red, yellow and green	signal repeaters, luminous
ii)	Roundel	—	89	—	red, yellow and green	miniature semaphore signals and disc signals
iii)	Roundel	—	213	—	red, yellow and green	UQ signals; LQ signals (spectacle types A, red only)
iv)	Roundel	—	245	—	red, yellow and green	LQ, signals
v)	Lens	outside step	92	16*	lunar white	route indicator (direction type)
vi)	Lens	outside step	140	13†	red, yellow and green	colour light signals (multi-unit type)
vii)	Lens	inside step	101	89	red, green lunar white and clear	point/trap indicators (target type) and shunt signal (position-light type, clear only)
viii)	Lens	inside step	136	89	red, yellow, green and clear	hand and temporary engineering signal lamps and semaphore signal lamps (dear only)
ix)	Lens	inside step with moulded prism for close up indication	127	70	clear	route indicators (direction type)
x)	Lens	inside step with moulded prism for close up indication	213	102	clear	colour light signals (multi-unit type)
xi)	Lens	inside step spread light	136	89	clear	semaphore signal lamps
xii)	Lens	inside step spread light	213	102	clear	colour light signals (multi-unit type)

*Refers to doublet combination of the lens with 127 mm diameter, 70 mm focal length inside step clear lens.

†Refers to doublet combination of the lens with 213 mm diameter, 102 mm focal length inside step clear lens.

4.2.2 The seating surface of the roundels and lenses shall be plain and free from sharp edges or fins.

4.3 Colour and Light Transmittance — When tested in accordance with the method given in Appendix A, the colour and transmittance of various types of signal roundels and lenses shall be as under. These limits are also shown in Fig 1.

> NOTE — The limits of the red and yellow in this standard should be read in conjunction with one another, and red glasses conforming to this standard should be used only in combination with yellow glasses conforming to the same specification and *vice versa.*

a) *Setp Lenses*

Red	Y not greater than 0.295 Z not greater than 0.007 Transmittance not less than 8 percent
Yellow	Y not greater than $X - 0.140$ Y not less than $X - 0\ 175$ Y not less than $0.790 - 0.667\ X$ Transmittance not less than 25 percent
Green	X not greater than $Y - 0.190$ X not greater than $0.710 - Y$ Y not leu than 0.420 Transmittance not less than 12 percent
Lunar White	X not greater than 0.420 X not less than 0.365 Y not greater than $0.510\ X + 0.190$ Y not less than $0.510\ X + 0.175$ Transmittance not less than 22 percent

b) *Moulded Semaphore Glasses*

Red	Y not greater than 0.295 Z not greater than 0 007 Transmittance not less than 8 percent
Yellow	Y not greater than 0.407 Y not less than 0.386 Y not less than $0.790 - 0.667\ X$ Transmittance not less than 25 percent
Green	X not greater than $Y — 0.190$ X not greater than $0.710 - Y$ Y not less than 0.420 Transmittance not less than 12 percent
Lunar White	X not greater than 0.420 X not loss than 0.365 Y not greater than $0.510\ X + 0.190$ Y not less than $0.510\ X + 0\ 175$ Transmittance not less than 22 percent

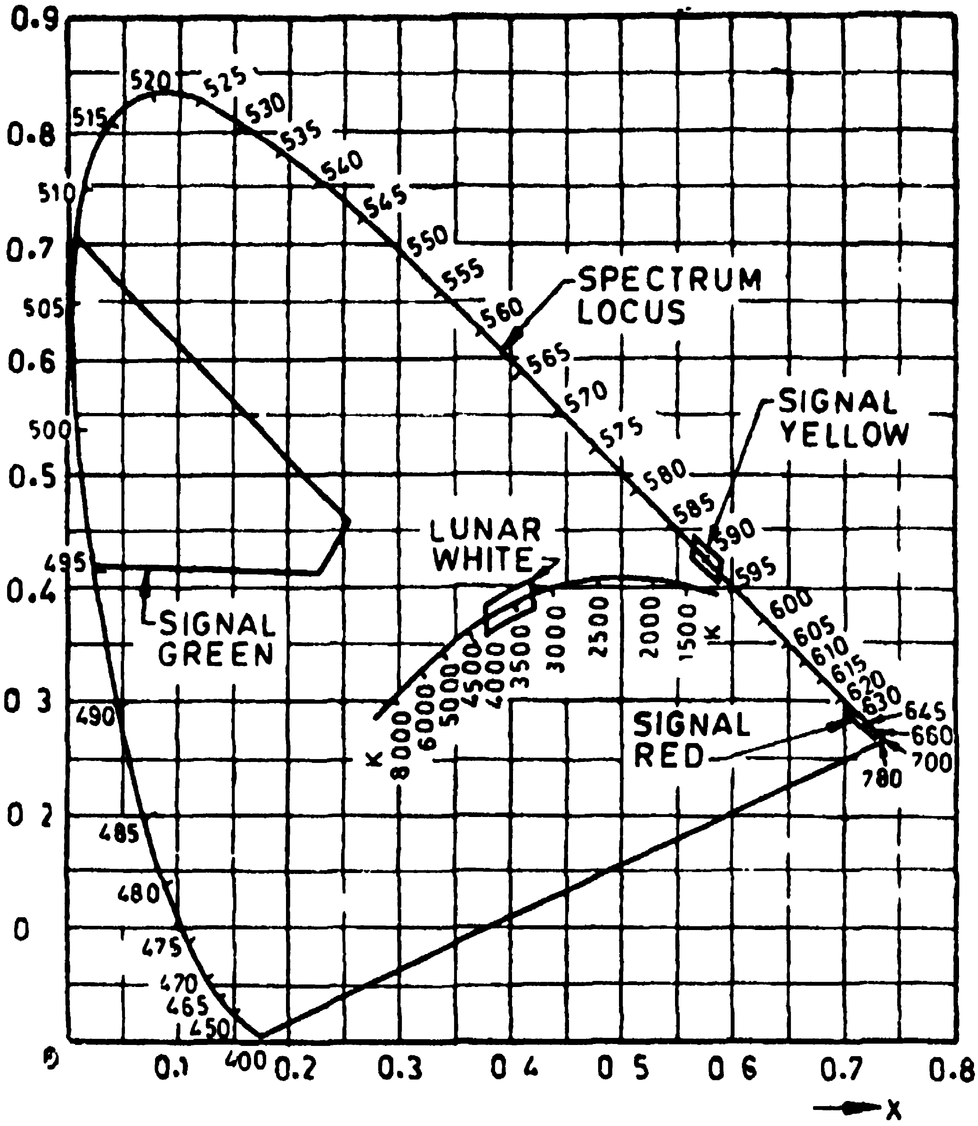

FIG. 1 CHROMATICITY LIMITS FOR SIGNAL COLOURS

4.3.1 The colour of signal roundels and lenses shall be red, yellow, green, lunar white or clear as given in Table 1.

4.3.2 No dark annular ring shall be visible when a point source of light is placed at the focal point of a lens or doublet combination of lenses and viewed from opposite side.

4.4 Focal Length — In the case of inside-step lenses and doublet combination lenses, the focal length shall be within ± 3 mm and ± 1.5 mm, respectively of the specified value given in col 5 of Table l, when determined in accordance with the method prescribed in Appendix B.

4.5 Horizontal Spread — In the case of spread-light lenses, the horizontal spread, unless specified otherwise, shall be within 8 ± 1° when measured along the axis at a distance not lew than 5 m from the lens in accordance with a method agreed to between the purchaser and the supplier.

4.6 Dimensions — The roundels and lenses shall conform to the dimensions given in the drawings approved by the purchaser.

4.6.1 Tolerances on the dimension of roundels shall be as agreed to between the purchaser and the supplier.

4.6.2 Tolerance on the dimensions of lenses shall be as follows:

Type of Lens	*Tolerances,* mm
a) Outside step for inner lens of doublet combination	+ 0.0 – 1.0
b) Inside step, up to 160 mm diameter	+ 0.0 –1.5
c) Inside step over 160 mm diameter	+ 0.0 –3.0

5. TESTS

5.1 Type Tests — The following shall constitute type tests and shall be carried out in the following sequence:

a) Visual inspection (*see* **3.1, 4.1, 4.2, 4.2.2, 4.3.2** and **4.6** to **4.6.2**);

b) Colour and light transmittance (*see* **4.3** and Appendix A);

c) Focal length (*see* **4.4** and Appendix B);

d) Horizontal spread (*see* **4.5**);

e) Resistance to thermal shock (*see* **4.1.2**);

f) Limit of alkalinity (see **4.1.1**); and

g) Annealing (*see* **4.2.1**).

5.1.1 The required number of signal roundels and lenses for the first sample *(see* col 3 of Table 2, in Appendix C) shall be selected for the typo tests except for limit of alkalinity and annealing tests for red colour roundels and lenses. All the samples shall be considered to have satisfied the above tests if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 5 of Table 2 (*see* **C-2**). In case the number of defectives found in the first sample lies between corresponding acceptance and rejection number, a second sample of the size given in col 3 of Table 2 shall be examined for all the tests or for specific tests in which the samples have failed. All the samples shall be considered to have satisfied if the number of defectives found in the cumulative number is less than or equal to the corresponding acceptance number given in col 5 of Table 2 (*see* **C-2**).

5.1.2 For testing for limit of alkalinity and annealing, only one sample for each test shall be taken and it shall not fail.

5.1.3 All roundels and lenses of red colour shall be tested for compliance with colour and light transmittance test.

5.2 Acceptance Tests — The following shall constitute acceptance tests:

a) Visual inspection (*see* **3.1, 4.1, 4.2, 4.2.2, 4.3.2** and **4.6** to **4.6.2**);

b) Colour and light transmittance (*see* **4.3** and Appendix A);

c) Focal length (*see* **4.4** and Appendix B);

d) Horizontal spread (*see* **4.5**);

e) Resistance to thermal shock (*see* **4.1.2**);

f) Limit of alkalinity (*see* **4.1.1**); and

g) Annealing (*see* **4.2.1**).

5.2.1 All roundels and lenses of red colour shall be tested for compliance with colorimetric tests; for the remaining acceptance tests, sampling procedure given in Appendix G shall be adopted.

5.2.2 For roundels and lenses other than red, sampling procedure given in Appendix G shall be followed for all the acceptance tests.

5.2.3 The rejected roundels and lenses shall be rendered unusable in the presence of the purchaser or his nominee.

5.3 Routine Tests — The following shall constitute routine tests:

a) Visual inspection (*see* **3.1, 4.1, 4.2, 4.2.2, 4.3.2** and **4.6** to **4.6.2**); and

b) Colour and light transmittance (*see* **4.3** and Appendix A).

NOTE—The manufacturer shall certify that the routine tests have been carried eat on the lots offered for inspection.

6. PACKING AND MARKING

6.1 Packing — Each roundel or tens shall be wrapped with a piece of paper of corresponding colour and shall then be packed in suitable packing cases. The roundels and lenses of different types, sizes and colours shall be distinguishable when packed.

6.2 Marking — The signal roundels and lenses shall be clearly and indelibly marked with the following:

a) Name of the manufacturer or his recognized trade-mark, if any;

b) Nominal diameter;

c) Nominal focal length (of the lens);

d) Degree of horizontal spread of spreadlight lenses; and

e) Year of the manufacture.

6.2.1 The roundels and lenses may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark it governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. SAMPLING

7.1 Representative samples of signal roundels/lenses shall be drawn and conformity of the material to the requirements of this specification shall be determined in accordance with the procedures prescribed in Appendix C.

APPENDIX A

(*Clause* 4.3)

METHOD OF TEST FOR COLOUR AND TRANSMTTTANCE

A-0. GENERAL

A-0.1 Measurement of chromaticity and transmittance may be made with a colorimeter, by spectrophotometric analysis, by comparison with calibrated colour filters or by any method which gives results in terms of the system recommended by the International Commission on Illumination (CIE) in 1931.

NOTE — Calibrated colour filters for use in these tests shall have been tested and certified for their chromaticity and transmittance by the National Physical Laboratory (CSIR), New Delhi, or any other approved laboratory.

A-0.2 Two methods of test have been prescribed. Method A is based on the use of a colorimeter or spectrophotometer and Method B is based on visual inspection using standard calibrated glasses.

NOTE — Method B may be adopted where a larger number of signal roundels and lenses have to be tested and where a lower order of accuracy is permitted.

A-1. REFERENCE TEMPERATURE

A-1.1 As certain coloured glasses are liable to change in chromaticity and transmittance with change in temperature, tests shall be carried out at an ambient temperature of 27 ± 2°C.

A-2. METHOD A

A-2.1 Apparatus

A-2.1.1 *Colorimeter or Spectrophotometer*

A-2.1.2 *Light Source* — The light source shall comprise a tungsten filament lamp with a translucent white opal screen of appropriate size, or alternatively with a magnesium oxide screen.

NOTE — The screen shall be regarded as the light source, and the lamp shall be operated so that the colour temperature of the light emitted from the screen is 2 856°K.

A-2.2 Procedure

A-2.2.1 *Chromaticily* — Set up the apparatus with the light source operating as prescribed in **A-2.1.2** and measure chromaticity as detailed below, taking care to eliminate stray light from other sources so that chromaticity of light passing through the signal roundel or lens only is measured.

A-2.2.1.1 *Plain colour filters* — Chromaticity of a plain glass colour filter shall be taken as the chromaticity of the light passing normally through it.

A-2.2.1.2 *Lens* — Place the light source (*see* **A-2.1.2**) at the focus of the lens conjugate to the magnesium oxide screen which shall receive light from the whole effective area of the lens. The distance between the lens and the magnesium oxide screen shall not be less than five times the diameter of the lens; and the effective diameter of the light source shall not be less than one quarter of the focal length of the lens. Chromaticity of the lens shall be taken as the chromaticity of light reflected at 45° from the magnesium oxide screen.

NOTE — When the effective area of a signal roundel or lent is less than its total area, this should be indicated by the user and a suitable screen making all light except that passing through the effective area should be used while taking measurements.

A-2.2.1.3 *Diffuser* — For measuring chromaticity of a diffuser, place it in close proximity to a colourless condensing lens set up in relation to the light source and the magnesium oxide screen as in **A-2.2.1.2**. The diameter of the condensing lens shall not be less than that of the diffuser and care shall be taken that no direct light reaches the magnesium oxide screen.

NOTE — If the condensing lens is not colourless, correction may be made by adjusting the light source so that the light passing through the lens has a colour temperature of 2 856°K.

A-2.2.1.4 *Spreader* — For measuring chromaticity of a spreader follow the procedure prescribed for diffuser (*see* **A-2.2.1.3**) and take measurements on the axis and also in the direction of minimum spread.

A-2.2.2 *Transmittance* — The arrangement for illuminating the coloured filters of unknown transmittance and for observing the light transmitted by them, shall be as given in **A-1.1**, **A-2.1, A-2.2.1** and **A-2.1.2** except that in this case the measurement is of the luminance of the screen rather than of its chromaticity. The uncoloured flat glass and the coloured flat glass of known transmittance shall be mounted close to the aperture of the photometer or colorimeter.

A-2.2.2.1 Transmittance of a coloured filter is measured in combinations with a colourless flat glass and compared by substitution with the transmittance of an uncoloured filter of the same pattern as the coloured filter under test in combination with a calibrated coloured flat glass of known transmittance. Transmittance of diffusers and spreader shall be measured for light emitted in the direction of the optical axis.

NOTE — Transmittance of the flat glass may be measured with a colorimeter or may be calculated from its spectural absorption curve.

A-2.2.2.2 The ratio of the luminance of the magnesium oxide screen when the coloured filter (under test) and the colourless flat glass are in position, to the luminance when the uncoloured filter and the coloured flat glass (of known transmittance) are in position, is equal to the ratio of the transmittance of the coloured filter (under test) to the transmittance of the coloured flat glass (of known transmittance), provided the absorption in the uncoloured filter is equal to that in the uncoloured flat glass. If these absorptions differ, a correction shall be made.

NOTE — If the transmittance measurement are made with a visual photometer, a coloured flat glass having properties similar to those of the calibrated coloured flat glass should be mounted on the comparison side of the photometer to eliminate the difficulties of heterochromatic photometry but the properties of this glass may not be known.

A-3. METHOD B

A-3.0 General — The method consists of visually comparing the signal roundels and lenses under test with standard glasses known to comply with requirements prescribed for chromaticity and transmittance. One standard calibrated glass is required to test the colours of red signal roundels and lenses filters of each glass type, and two for both yellow and green signal filter. One calibrated glass is required to test the transmittances of signal filters of each glass type.

A-3.1 Apparatus

A-3.1.1 *Standard Calibrated Glasses*

A-3.l.1.1 *Glass type* — Glasses calibrated for chromaticity and transmittancy tests shall be made of the same type of glass as the signal roundel and lens to be tested. Glasses calibrated for chromaticity and transmittance tests shall also be of the same type of glass as the signal glass but the addition of a neutral glass is permissible.

A-3.1.1.2 *Form* — It is desirable that the calibrated glasses shall be about 60 mm square transparent filters with reasonably flat and parallel surface of such quality that the filters can be calibrated with a spectrophotometer, or can be used in the substitution method (*see* **A-2.2.2.1**).

A-3.1.1.3 *Identification* — Each calibrated glass shall be marked with the glass type, the colour limit that it interprets, the colour temperature of the source with which it is to be used, and with a reference mark.

A-3.1.1.4 *Uniformity* — With a lamp at a colour temperature of 2 856°K as the light source, the transmission factor of each calibrated glass, at each of the four points midway between the centre and corners, shall be between 0.95 and 1.05 times the central value.

A-3.1.1.5 *Chromaticities* — The chromaticities of roundels/lenses calibrated for colour tests shade as specified in **4.3** with colour temperature 2 856°K.

A-3.1.1.6 *Transmittance* — The transmittance of glasses calibrated for colour tests need not comply with the transmittance requirements of **4.3**.

The transmittance of glasses calibrated for transmittance tests with the light source at a colour temperature of 2 856°K, shall be between the minimum transmittance requirements specified in **4.3** and these values multiplied by **1.05**.

A-3.1.2 *Diffusion Box* — A diffusion box of the type and dimensions shown in Fig. 2 is recommended. The mound for the signal roundels and lenses under test shall be adjustable for their focal lengths so that the source is exactly at a distance equal to the focal length of the filter. The box shall be provided with mounts having different apertures for use with signal roundels and lenses of different diameters.

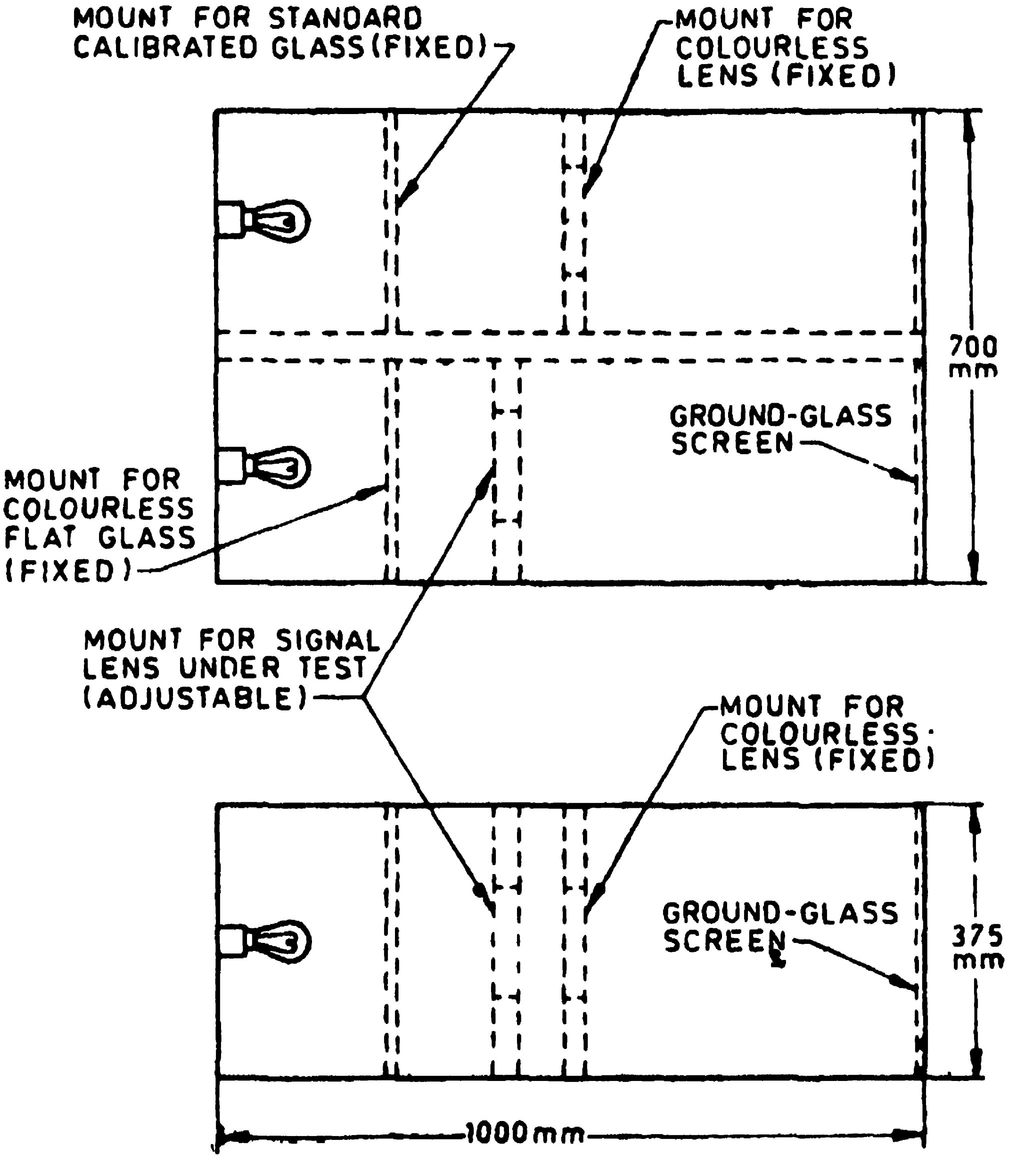
MOUNT FOR STANDARD CALIBRATED GLASS (FIXED)
MOUNT FOR COLOURLESS LENS (FIXED)
700 mm
GROUND-GLASS SCREEN
MOUNT FOR COLOURLESS FLAT GLASS (FIXED)
MOUNT FOR SIGNAL LENS UNDER TEST (ADJUSTABLE)
MOUNT FOR COLOURLESS LENS (FIXED)
GROUND-GLASS SCREEN
375 mm
1000 mm

FIG. 2 DIFFUSION BOX

A-3.2 Procedure — Mount the standard filter and the signal roundel and lens to be tested in the diffusion box with the light source operating at prescribed in **A-2.1.2**. In the case of outside step lens, use a condensing lens both in front of the test piece as well as of the standard lens.

A-3.2.1 *Colour* — Compare the colours visually. Signal red roundels and lenses shall be not yellower than the yellow-limit calibrated glass for red glasses of the same glass type; signal yellow roundels and lenses shall be neither greener than the green-limit calibrated glass nor redder than the red-limit calibrated glass for yellow glasses of the same glass type; signal green roundels and lenses shall be neither bluer than the blue-limit calibrated glass nor yellower than the yellow-limit calibrated glass for green glasses of the same glass type.

A-3.2.2 *Transmittance* — Compare the transmittance of the signal roundels and lenses with the standard filter. The transmittance of the glass under test shall not be less than that of the standard filter.

NOTE — Companion of transmittance using a photoelectric cell, however, is more convenient.

APPENDIX B

(*Clause* 4.4)

DETERMINATION OF FOCAL LENGTH

B-1 APPARATUS

B-1.1 Optical Bench

B-1.2 Point Source of Light — A SL-5 lamp according to IS : 9589-1980* suitably mounted on the optical bench.

B-1.3 Mirror — For viewing the emerging beam of light placed at a distance of 15 metres from the lens under test.

B-2. PROCEDURE

B-2.1 Mount the lens on the optical bench in front of the point source of light to that the latter can move along its axis. Slide the light source along the axis of the mirror towards or away from the lens under test till a uniform bright flash of light is observed in the mirror. Measure the axial distance between the plane of seating of the lens and the light source accurately as the focal length of the lens.

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*Electric lamps for railway signalling.

B-2.2 In the case of doublet combination of lenses, mount the combination on the optical bench and measure the focal length as in **B-2.1** as axial distance between the plane of the seating of the inner outside step lens and light source.

APPENDIX C

(*Clauses* 5.2 *and* 7.1)

SAMPLING OF SIGNAL ROUNDELS AND LENSES FOR USE IN RAILWAYS

C-1. SCALE OF SAMPLING

C-1.1 Lot — In a single consignment, all the signal roundels and lenses of the same type, pattern and dimensions and manufactured under similar conditions shall be grouped together to constitute a lot.

C-1.2 For ascertaining the conformity of the material in the lot to the requirements of the specification, samples shall be tested from each lot separately.

C-1.3 The number of signal roundels and lenses to be sampled from each lot shall depend on the size of the lot and shall be in accordance with Table 2.

C-1.3.1 The signal roundels and lenses to be selected from a lot for drawing samples shall be chosen at random. In order to ensure the randomness of selection, procedures given in IS : 4905-1968* may be followed.

C-1.3.2 In case signal roundels and lenses are supplied in packages, at least 20 percent of the packages subject to a minimum of two, shall be chosen from the lot at random. From each of the packages, so chosen, approximately equal number of signal roundels and lenses shall be taken from different places so as to obtain the required number of samples.

C-2. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

C-2.1 The number of signal roundels and lenses given for the first sample in col 3 of Table 2 shall be examined for visual and optical requirements given in **4.2** to **4.6**. A signal glass failing in any of these requirements shall be considered as defective.

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*Methods for random sampling.

TABLE 2 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

(*Clauses* 5.1.1 *and* C-1.3)

SL. No.	NO. OF SIGNAL ROUNDELS AND LENSES IN THE LOT	VISUAL AND OPTICAL REQUIREMENTS					THERMAL SHOCK TEST		No. OF SIGNAL ROUNDELS AND LENSES FOR LIMIT OF ALKALINITY AND ANNEALING TESTS
		Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.	Sample Size	Accep-tance No.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Up to 300	First	32	32	1	4	4	0	1
		second	32	64	4	5			
ii)	301 to 500	First	50	50	2	5	5	0	2
		second	50	100	6	7			
iii)	501 to 1 000	First	80	80	3	7	8	0	2
		second	80	160	8	9			
iv)	1 001 to 3 000	First	125	125	5	9	13	0	3
		second	125	250	12	13			
v)	3 001 to 10 000	First	200	200	7	11	20	0	3
		second	200	400	18	19			
vi)	10 001 and above	First	315	315	11	16	32	1	4
		second	315	630	26	27			

C-2.1.1 The lot shall be considered to have satisfied these requirements if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 5 of Table 2.

C-2.1.2 The lot shall be rejected without further testing if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 6 of Table 2.

C-2.1.3 In case the number of defectives found in the first sample lies between corresponding acceptance and rejection numbers, a second sample of the size given in col 3 of Table 2 shall be examined for visual and optical requirements. A lot shall be considered to have satisfied visual and optical requirements if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 5 of Table 2; otherwise not.

C-2.2 The lot having been found satisfactory to **C-2.1** shall be simultaneously tested for thermal shock. For this purpose, required number of signal glasses shall be taken from those already examined and found satisfactory according to **C-2.1**.

C-2.2.1 The number of signal roundels and lenses to be tested for thermal shock shall be as given in col 7 of Table 2. The lot shall be considered to have met the requirements of thermal shock if the number of defectives found in the sample is less than or equal to the corresponding acceptance number given in col 8 of Table 2.

C-2.3 The number of signal roundels and lenses to be tested for limit of alkalinity and annealing shall be as given in col 9 of Table 2. The lot shall be considered to have met the requirement of limit of alkalinity and annealing if none of the sample signal roundels and lenses tested found to be defective.

C-2.4 The lot shall be declared as conforming to the requirements of this specification if **C-2.1**, **C-2.2** and **C-2.3** are satisfied.

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